Framing Climate Risk in Portfolio Management

Policies to regulate greenhouse gas emissions caused by human activities are being developed and implemented in major markets around the world. Because these new policies bring with them costs as well as opportunities, prudent investors will factor climate risk into investment decisions. This report provides investors with a multidimensional framework for assessing climate risk in their portfolios. This tool stresses the competitive dynamics resulting from climate policies as the most important investment issue.

Different types of climate policies can have different effects on industries and on companies in the same industry. This report shows how the structure of these policies will shape companies' competitive responses. Both policy design and competitive response will define the impact on company finances. Despite uncertainties, especially in the United States, investors can use existing financial techniques to discount the potential consequences of climate policies in valuing their investments.

KEY POINTS

- Climate change presents industries and companies with both risks and opportunities. The framework explained in this report is intended to help investors identify and evaluate the impact of climate risk on their portfolios.
- Advances in scientific understanding of the causes of climate change are driving international, regional, national, and state policies to regulate greenhouse gases (GHGs). As more and more governments adopt policies to limit greenhouse gas emissions, pressure is building on the United States to do the same.
- For investors, GHG regulatory risk and its competitive implications are the most immediate and tangible aspects of climate risk.
- To accurately analyze the implications of policies to regulate GHG emissions, investors should consider how companies respond competitively to these policies and ultimately how this affects cash flows.
- Prudent investors will pay close attention to climate risk in the auto, electricity, and oil and gas industries. In evaluating their portfolios, investors can use existing financial techniques to assess the risk of future climate policies. This consideration is particularly important in the United States, where lack of federal GHG constraints leaves great uncertainty about the future regulatory environment.

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A FRAMEWORK FOR CLIMATE RISK ANALYSIS

Institutional investors—and the companies in which they invest—try to invest capital in a way that minimizes risk and maximizes return. In security markets, nearly all portfolio investments are based on portfolio theory, which is founded on the premise that investing in diversified assets reduces risk across a portfolio while maintaining a given level of expected return.[1] In other words, a successful portfolio combines investments in different industries to maximize returns while minimizing risk. Box I explains the difference between risk and uncertainty.

Diversification of investments means that asset returns will not depend on the same economic variables and will therefore not move in parallel under the same economic conditions.[2] For example, shares of home building companies usually move in the opposite direction of interest rates.

In reality, a truly diversified portfolio is almost impossible because most assets depend on similar economic conditions such as consumer spending or interest rates and, to some extent, move in the same direction as the entire economy. In portfolio theory, this aspect of risk, called "systematic risk," (or market risk), cannot be diversified away. Risk that is particular to a specific industry or company, called "unsystematic risk," can be eliminated through diversification. However, traditional definitions of financial risk should be expanded to reflect emerging issues that will affect individual sectors or companies. Investors can use a portfolio theory to begin to assess how climate change can affect investments.

Box I. Risk versus Uncertainty

Investors looking at the financial effects of climate policy must differentiate between risk and uncertainty. In the context of investment analysis, *risk* can be considered as a mathematical distribution of potential outcomes around known parameters, even if the actual parameters and shape of the distribution is in dispute. *Uncertainty*, on the other hand, involves a lack of information for determining the parameters with which to assess investment risk.[a]

Uncertainty on climate change is related mainly to the policy framework under which greenhouse gases will be regulated.[b] Without certainty on climate policy, its financial and competitive implications cannot be accurately assessed. In other words, uncertainty is the absence of reliable information on the future structure of a climate regulatory framework. Risk, on the other hand, is related to the individual company's competitive response to the chosen policy environment. Put another way, uncertainty is related to the policy framework while *risk is related to the consequences of the chosen policy.* For example, in Europe climate regulatory risk can be analyzed because the parameters around policy are generally known. However, in the U.S. not only is the likely future structure of policy not known, but competitive responses by companies to these polices are difficult to estimate.

a. A substantial body of economic research is available on this topic. The foundation was established in Frank Knight's book, *Risk, Uncertainty and Profit.* (Boston, Mass,: Houghton, Mifflin Company, 1921).

b. The extent of physical climate risk is also uncertain. This report acknowledges that climate risk contains a physical component but focuses on the uncertainty surrounding the *policy response* to control GHG emissions.

Climate Risk Poses Both Systematic and Unsystematic Risk to Portfolios

Using portfolio theory, climate risk can be broken down into two constituent components that together make up a portfolio's total climate risk exposure, systematic risk and unsystematic risk.

Systematic risk is associated with macro concerns such as overall economic and market risk. Climate change, and policies to combat its impacts, will create systematic risk across the entire economy, affecting energy prices, national income, health, and agriculture. As a systematic risk, it will disproportionately affect energy production and consumption. More research and sophisticated modeling will be necessary to quantify how systematic climate risk will be distributed throughout the economy. Although climate risk has a systematic element, this paper explores issues around unsystematic climate risk and its implications for portfolio management.

Unsystematic climate risk (including both issuer and sector risk in this context) is the component of investment risk particular to a specific security. With respect to issuer risk, for instance, returns on equity investments are determined by a company's underlying financial performance on earnings, profitability, and return on invested capital. A company's financial performance is, in turn, influenced by competitive positioning around issues affecting the industry as a whole. Sector risk affects all companies in a given sector, for example due to potential regulations, class action lawsuits, or shifts in demand. Figure I illustrates how unsystematic climate risk can be deconstructed into sector-specific and company-specific risk.

This Framework Can Be Used to Analyze Climate Risk across a Portfolio

The key question for investors considering the implications of climate risk is: "Under what circumstances might climate change affect my portfolio—and to what degree?"[3] To answer that question, investors must consider:

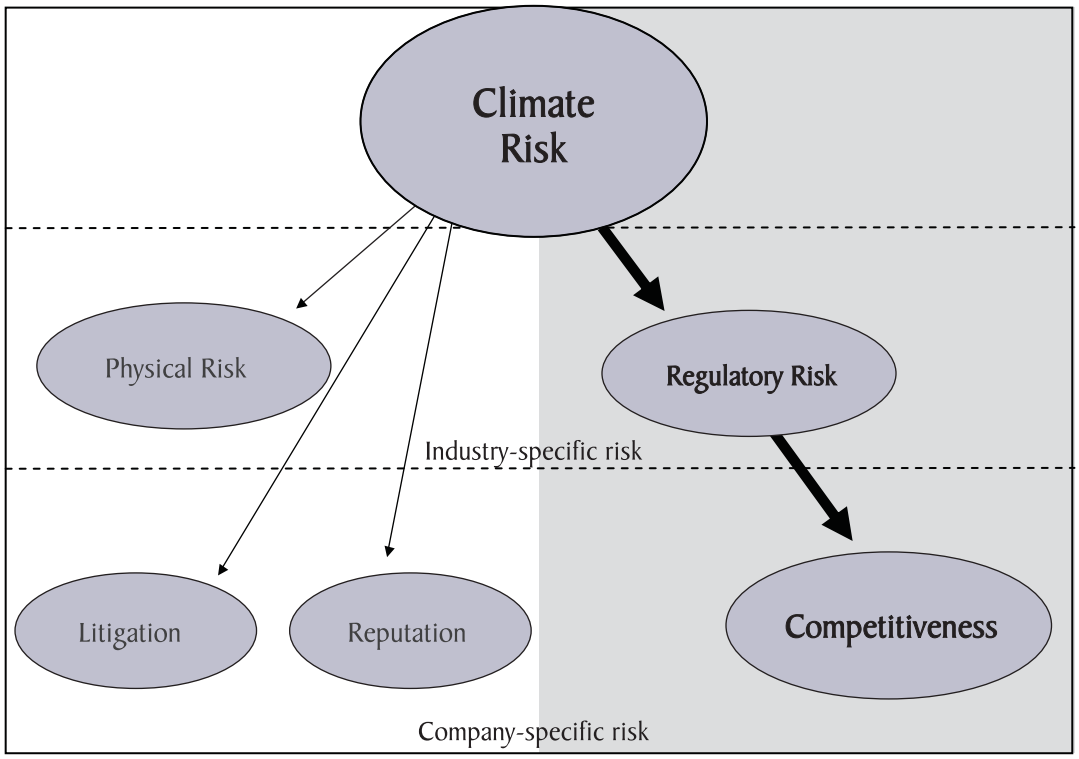

Figure I. How Climate Change Influences Corporate Value

Source: WRI Capital Markets Research.

- By what mechanisms might climate risk affect company and portfolio performance?
- What financial and competitive repercussions might each mechanism have?

Investors can begin to investigate the first question using the framework sketched in Figure I. Yet, a company's competitive positioning in response to climate policies will reflect for investors the most immediate and tangible aspect of a company's exposure to climate risk. Therefore, to answer the second question, investors will need information about the structure of climate policy.

Each mechanism of climate risk presents investors with different analytical problems. Overlooking the financial consequences of these mechanisms could lead to an insufficient assessment of risk in some companies. This framework and the rest of this paper deal exclusively with how to assess the risk climate change poses to investments.

There are two types of climate-related risk:

- *Sector-specific risk*, the risk posed to all companies in a sector or industry.
- *Company specific risk*, the risk posed to specific companies in a sector or industry.

Sector-Specific Risk

Sector-specific risk consists of regulatory risk and physical risk.

Regulatory risk. International, national, regional, and state regulation of greenhouse gases (GHGs),[4] depending on the stringency, is likely to have a financially material effect on most GHG-intensive sectors, because it will create a cost for carbon dioxide (CO_2) and other GHG emissions.

Physical risk. Some sectors of the economy will be directly affected by the physical effects of climate change such as droughts, floods, storms, and rising sea levels. Agriculture, fisheries, forestry, health care, insurance, real estate, tourism, and water may be particularly exposed because of their dependence on the physical environment, human health, water, and weather—all directly affected by climate change. The competitive implications of physical climate risk will be felt over a longer timeframe. Precisely how this risk will manifest itself throughout the economy is uncertain, but some sectors will benefit while others could face difficulties.

Company-Specific Risk

Company-specific risk encompasses competitive risk, litigation risk, and reputational risk.

Competitive risk. Within any climate regulatory framework, some companies will fare better than others. Individual companies could win or lose depending on the policy framework. In portfolio management, this dynamic is most important in determining the effects of GHG constraints on investment valuation.

Litigation risk. High GHG-emitting companies could face risk in the form of lawsuits similar to those in the tobacco, pharmaceutical, and asbestos industries. For instance, in an initiative led by New York Attorney General Eliot Spitzer, eight states and New York City have filed an unprecedented lawsuit against five of America's largest power companies, demanding that they cut CO_2 emissions.[5] At this time, the prospect of climate change lawsuits is hard to factor into the valuation of individual corporations, and it is unlikely that any financial impacts will be felt in the near term.

Reputational risk. Companies viewed negatively with respect to climate change (for their politics, products, or processes) could run into consumer or shareholder backlash in environmentally sensitive markets. This is especially relevant in highly competitive sectors such as automobiles and fuel service stations where brand loyalty is an important attribute of company value. As with other reputational issues, costs or benefits are difficult to project accurately into security valuations.

Companies will be exposed to different aspects of climate risk depending on the sector and the geographic location of their operations. Broadly speaking, however, investors should first assess sector-specific climate risk in their portfolios. For example, energy-intensive industries will be affected by GHG regulations more than, say, technology or pharmaceutical companies, while agriculture will be more sensitive to the physical effects of climate change. Yet, investors should pay more attention to the emerging competitve dynamics that are created by climate policies.

Investors Should Focus on the Competitive Implications of Climate Policies

Climate policies are increasingly likely to have a financial impact (positive or negative) on many sectors. Although a sector-level analysis of climate risk is important, the more significant analytical process is to determine a company's strategy around climate policies in order to choose companies with limited risk exposure and better competitive positioning. Because no two companies will be affected the same way by climate policies, investors should concentrate on competitiveness, which provides an opportunity to separate climate winners from climate losers. The proximity and materiality of climate regulations for a number of sectors make this the appropriate analytical path to rebalance portfolios or take other steps to mitigate climate risk. In time, though, and with more information, investors will also need to quantify the impacts of other mechanisms by which climate risk will affect their investments.

CLIMATE POLICIES AROUND THE WORLD ARE GAINING MOMENTUM

Momentum has been gathering for the enactment of policies to regulate GHGs. Regardless of where they do business, it will be increasingly difficult for companies in GHG-intensive sectors to escape GHG policies and regulations. The structure and geographical overlap of these policies is what will shape climate competitveness.

Companies in GHG-intensive sectors will be subject to regulations and standards in the European Union (EU), Canada, Japan, Australia, Russia, and some U.S. regional markets. Also, regulations on fuel economy and CO_2 emissions in the automotive sector in these markets (and China)[6] will affect the finances of auto companies operating there.

The *EU* has moved aggressively to reduce GHG emissions. It adopted the Kyoto Protocol in 2002 (Box 2) and started the Emission Trading Scheme (ETS) in 2005, setting CO_2 emission limits for companies in the cement, oil refining, power, pulp and paper, and steel industries.[7] These policies will influence competitiveness and valuations in these sectors. Already in 1998, the EU struck a voluntary agreement with automobile manufacturers to reduce CO_2 emissions on new passenger cars by 25 percent by 2008 (and possibly by an additional 10 percent by 2012).[8] The European Commission has stated that it will regulate the industry if it fails to meet these standards. Thus, the European automobile sector will also experience climate competitiveness issues going forward.

Canada, like the EU, has committed to the Kyoto Protocol and is obligated to reduce its GHG emissions as prescribed by the treaty. For large final emitters, the Climate Change Plan for Canada establishes a three-prong approach on reduction targets, emissions trading, and technology standards.[9] The government has also reached an agreement with the automobile industry to reduce CO_2 emissions from new vehicles by 25 percent by 2010.[10]

Japan has also ratified the Kyoto Protocol and has designed an implementation plan requiring GHG-reduction targets for major economic sectors. This plan includes an increase in fuel economy standards for passenger vehicles, new standards for commercial vehicles and aircraft, tax incentives for low-emission vehicle technologies, and overall energy efficiency improvements in the economy.

In *Australia,* despite the federal government's rejection of the Kyoto Protocol, state and territory leaders agreed in March 2005 to establish their own interstate GHG emissions trading system. Details of this system are still unclear.

Russia ratified the Kyoto Protocol in November 2004. However, because industrial production has dropped since 1990 (Kyoto's

Box 2. The Kyoto Protocol

In 1992, the United Nations Framework Convention on Climate Change (UNFCCC) began to negotiate a global treaty to reduce GHG emissions contributing to climate change. This process resulted in the Kyoto Protocol, which was adopted at the Convention's third meeting in 1997 in Kyoto, Japan. The Kyoto Protocol requires that at least 55 percent of industrial countries' CO_2 emissions are included under the treaty before it enters into force. As of May, 2005, 149 nations have ratified the treaty, including developed countries responsible for over 60 percent of global CO_2 emissions. The Protocol went into effect on February 16, 2005.

base year), Russia will likely have a surplus of emission allowances to sell under the treaty.

The *United States*—unlike the EU, Canada, Japan, and Russia—has made no binding national commitments to reduce GHG emissions. However, as outlined in Box 3, several U.S. states have implemented or are studying climate policies. These regulations demonstrate a significant commitment to reducing GHG emissions on the part of state and local governments. Over time, the interstate regulatory burden may add momentum to growing pressures for U.S. action at the federal level.[11] This, coupled with a significant policy discrepancy with most of the industrial world could eventually lead the United States to reengage in global climate negotiations.

Indeed, leading U.S. companies facing potential climate regulations now say that GHG constraints are inevitable. For example, American Electric Power (AEP), the nation's largest electricity producer and source of CO_2 emissions has issued a special report to shareholders analyzing its exposure to GHG regulations. The report concludes that "…mandatory carbon constraints in the long-term appear probable" and "…initial mandatory reductions of greenhouse gas emissions are likely in the next decade."[12] In a similar report to shareholders, Cinergy stated that it eventually will operate its business in a carbon-constrained world.

Just how U.S. climate policy will evolve is still unclear, despite the trend around the world toward regulating GHG emissions. As electric power company TXU states in a recent report to shareholders on climate change, mandatory CO_2 controls on electric generators in the US are inevitable at some point, yet there is little agreement on the timing and the nature.[13]

Prudent investors will move beyond asking *whether* some form of climate policy is on the U.S. horizon, to considering *when* and *in what form*.

The extent to which climate policies affect companies depends greatly on the design, stringency, and timing of these regulations. New climate policies will change cost structures, create new markets and product opportunities, affect competition, and alter demand patterns. The financial implications of these policies cannot be accurately determined without knowing how companies are positioned around these new competitive parameters.

Box 4 outlines major policy options that have been used in climate policies around the world. Each option will have different implications for the way companies can respond to meet the regulations. For example, specific emissions limits or averaging mechanisms such as the Corporate Average Fuel Economy (CAFE) program in the United States are less flexible for manufacturers than an emissions trading program.

Although forecasting the exact financial implications of climate policies is difficult, industries that are a significant source of GHG emissions (directly or indirectly) will likely see a more pronounced impact than those that are not heavy emitters. GHG-intensive industries are also more exposed to U.S. policy uncertainty, which may increase the perceived risk associated with earnings streams in those industries. In addition, climate policies could create opportunities for some sectors (e.g., renewable energy and clean technology companies) that may be able to offer solution products and exploit rapidly expanding market opportunities. Moreover, the overlap of climate policy regimes within global markets will create an important set of competitive issues for multinational companies.

The Structure of Climate Policies Influences the Financial and Competitive Impacts on Companies

Assessing climate policy risk goes beyond simply determining which companies will or will not be regulated. Climate policies could affect different sectors in varying forms and over distinct timeframes. For instance, the power sector is likely, sooner or later, to face limits on GHG emissions and thus reflect these costs in electricity prices. Other large point emitters and the transport sector will either have GHG emissions capped (as in the EU) or be subject to technical standards (or possibly both).

Indeed, climate policies have various elements that are important to estimating competitive impacts for companies held in a portfolio. These include the following:

- The actual mix and design of various policy options including taxes, emissions trading programs or standards.[14] This can have significant impacts at the sector and company level.
- The relative stringency of the chosen policy design and mix.
- The sectors that will be regulated.

Box 3. U.S. State Climate Regulations

In the United States, state governments have taken the lead in regulating greenhouse gases (GHGs). As under different international regulatory plans, companies operating in states with climate-related regulations may face increased climate risk or competitive advantage compared to companies that do not operate in these states. It will be important for investors to find out how these state policies affect the financial performance of companies in their portfolio. Key state actions include:

California, in 2003, adopted legislation directing the California Air Resources Board (CARB) to achieve the maximum feasible and cost-effective reduction of greenhouse gases from California's motor vehicles. CARB has proposed a rule that would reduce emissions approximately 30 percent. The standard will take effect with 2009 model-year automobiles.

Maine, Massachusetts, New York, and *Vermont* have similar auto standards to California. *Connecticut, Oregon, New Jersey, Rhode Island,* and *Washington state* have announced that they also intend to follow them as well. Together with California, consumers in these states buy about 25 percent of all cars sold in the United States.

All of the *Northeast and Mid-Atlantic states* are studying or implementing programs to reduce GHG emissions. For example, in April 2000, New Jersey adopted a statewide goal of reducing GHG emissions to 3.5 percent below 1990 levels by 2005. Similarly, the New England governors and the Eastern Canadian premiers issued a Climate Change Action Plan in August 2001, calling for the reduction of GHGs to 10 percent below 1990 levels by 2020. New York's State Energy Plan calls for the reduction of the state's CO_2 emissions to 5 percent below 1990 levels by 2010 and to 10 percent below those levels by 2020. In April 2001, Massachusetts established a rule requiring designated power plants to reduce CO_2 emissions by 10 percent from 1997–1999 levels. Plants must meet the deadline by 2006, unless undertaking a fuel shift, in which case they may delay until October 2008. In May 2002, New Hampshire adopted limits on CO_2 emissions from power plants. By 2007, plants must reduce their emissions to their 1990 level. In summer 2003, Maine enacted a law requiring state officials to develop a climate action plan that would reduce CO_2 emissions to 1990 levels by 2010, and eventually reduce them by 80 percent. In 1998, led by Christine Todd Whitman who was then governor, New Jersey set a voluntary goal of reducing greenhouse gas emissions by 3.5 percent below 1990 levels by 2005. Legislation is also pending in Pennsylvania.

The *Regional Greenhouse Gas Initiative (RGGI)* will assist states in New England and the Mid-Atlantic in reaching such state-specific goals. RGGI will develop a cap-and-trade program to reduce CO_2 emissions from power plants in the participating states.

Oregon and Washington require new power plants to offset their CO_2 emissions.

Renewable portfolio standards. Eighteen states have adopted renewable portfolio standards (RPS) that require electric power companies to use increasing percentages of electricity produced from renewable sources such as wind and sun. Because of low emission electricity generation, these standards will reduce CO_2 and GHG emissions in Arizona, California, Colorado, Connecticut, Iowa, Maine, Maryland, Massachusetts, Minnesota, Hawaii, Nevada, New Jersey, New Mexico, New York, Pennsylvania, Rhode Island, Texas, and Wisconsin.

a. Regional Greenhouse Gas Initiative website at www.rggi.org (accessed March 2005).
b. Union of Concerned Scientists website: www.ucsusa.org. Accessed March 2005.

- The actual implementation of the chosen policy design. For instance, in emissions trading systems, direct allocation of allowances by governments may have different implications from "auctioning" allowances.[15]
- The timing of climate policy and regulatory action.
- The extent to which regulatory structures in other jurisdictions will be coordinated. This aspect of uncertainty is perhaps the most problematic because multinationals compete in an increasing number of jurisdictions that regulate GHGs.

All these considerations should enter into a prudent investor's analysis of climate policy risk across a portfolio. Judging by the already widespread use of emissions trading systems, future climate policies in the United States and elsewhere will allow emissions trading in some capacity to regulate emissions from the electricity and manufacturing sectors. Nevertheless, the financial impact on companies participating in such a system will be highly dependent on the design option chosen. For example:

- How high or low will the emissions cap be set, and how frequently will it be adjusted?
- Will the policy include only CO_2 or will other GHGs be included?
- What will be the initial allocation formula for emission allowances and will the formula be changed later?
- What is the base year for calculating the cap?
- Will emission offset credits be allowed (e.g., baseline and credit trading systems similar to the Clean Development Mechanism and Joint Implementation of the Kyoto Protocol)?

Box 4. A Brief Description of the Types of Climate Policies

Whether as part of the Kyoto Protocol, the European Union Emission Trading Scheme, or a different regulatory framework, policy measures to mitigate the impacts of climate change will focus on limiting CO_2 and other greenhouse gas (GHG) emissions. In practice, a wide range of measures could be introduced. They include: *GHG (or carbon) tax, GHG (or carbon) trading programs, process or product standards, and technology incentives.*

GHG (or Carbon) Tax

One policy option is to put a price on GHG emissions. This would increase the cost of fuels in proportion to their GHG content, creating an incentive for businesses and consumers to use less energy, less carbon-intensive energy, or both. Carbon taxes such as the Climate Change Levy in the United Kingdom are in place in a number of other EU countries.

GHG (or Carbon) Trading Programs

Cap-and-trade programs. A cap-and-trade program, similar to programs used to control acid rain in the United States, would establish incentives similar to a tax by requiring allowances for emitting GHGs. By controlling supply, these allowances would command a market price that companies and consumers could avoid by reducing their GHG emissions. (Because of this, cap-and-trade programs generate similar outcomes to tax systems). This system involves trading of emission assets, where the total supply of allowances is limited or "capped." Participants can buy or sell additional assets but must surrender sufficient assets to cover their own emissions liability as determined at the end of the accounting period. Cap-and-trade systems can include multiple pollutants across different sectors. Allowances can be distributed either through an auction or through a government allocation formula, for example, based on historic emissions. Most cap-and-trade systems have relied on allocation formulas that distributed the permits free of charge by "grandfathering" allowances.

Baseline-and-credit programs. This system relies on emission profiles or "baselines" for specific projects designed to reduce emissions. As the projects are implemented, the emission reductions can be calculated by the project developer and then certified by an authority, resulting in the creation of emission reduction credits. These credits can be securitized and traded to other entities. In the absence of a binding cap on emissions, however, baseline-and-credit systems need to provide some incentive to trade.

Process or Product Standards

Instead of creating financial incentives to reduce GHG emissions, governments could set GHG standards for certain industry processes and products. For example, in markets that are responding to climate change such as Canada, China, Japan, Australia, and the EU, new standards set future limits on either fuel consumption or emissions of CO_2 from automobiles. A similar approach has been legislated in California.

Technology Incentives

A variety of existing and proposed regulations provide incentives for cleaner technologies. One example of this type of incentive is the Energy Production Tax Credit in the United States, which provides a 1.8-cent per kilowatt hour benefit to wind, geothermal, solar, bioenergy, small irrigation power, and municipal solid waste electricity sources for the first 10 years of a facility's operation.

a. Grandfathering allowances refers to a situation in which installations are granted allowances free of charge based on historic emissions data.

b. "*Renewable Energy Tax Credit Saved Once Again, but Boom-Bust Cycle in Wind Industry Continues*" Union of Concerned Scientists website. **www.ucsusa.org/clean_energy/renewable_energy** (accessed April 2005).

- Will companies be allowed to "bank" allowances for future commitment periods?
- Will tradable emission assets be fungible across regional and international trading systems?

Although any climate regulatory structure in the United States is likely to rely largely on a cap-and-trade system, feasible implementation solutions are hard to identify. Most GHG emissions come from a number of industrial sources, and many of them have banded together to resist climate mitigation policies. Thus, for political reasons, many proposed climate policies that appear most viable could either exempt certain sectors (greatly undermining the effectiveness of the policy) or financially compensate some sectors for changes that their businesses may have to make. How far this will affect investments in these sectors is difficult to predict.

Despite the uncertainty about future policy structure in the United States, some researchers have isolated some policy options and attempted to estimate their economic implications for different sectors. According to a report by Resources for the Future (RFF), the financial impact of a climate policy that includes either carbon taxes or tradable permits could vary from sector to sector depending on the chosen policy structure.[16] Charles River Associates (CRA) assessed the impact of a policy that reduces U.S. CO_2 emissions to 7 percent below 1990 levels by 2010 and 2030.[17] CRA also found significant differences in the potential impacts of climate policies, although the sectors analyzed, the scenarios modeled, their many underlying parameters, and the forecasts for each sector differ from those in the RFF model.

Despite these differences, both studies point to the variability of financial impacts depending on policy design. In other words, a carbon tax scenario could have different implications from an emissions trading system. Moreover, these studies highlight that, even within a given policy framework, decisions regarding implementation and design can have quite different financial impacts. For instance, in a cap-and-trade system, decisions on allowance allocation (which can be highly political) can produce different economic circumstances.

In addition to differences between sectors, each company will also be positioned differently to respond to the climate regulations. In the power sector, for example, a company's generating assets, installed technologies, fuel mix, and market position will shape specific impacts and risks. Some power companies may be at greater risk because they are heavily invested in producing power from carbon-intensive coal, while others have substantial investments in cleaner production using sources such as natural gas. Auto companies that have committed heavily to sport utility vehicles (SUVs), which have greater GHG emissions than other models, could face risk from competitors that are better equipped to meet new climate policies or fuel economy requirements.

WRI and SAM Group have conducted several assessments of automotive companies' positions with respect to GHG constraints (or policies to limit oil consumption for energy considerations). According to *Changing Drivers,* U.S., EU, and Japanese auto companies are positioned differently with respect to existing and proposed regulations.[18] Figure 2 illustrates that low-carbon technology auto companies (upper right quadrant) should have a competitive advantage over the rest of the industry in both cost exposure and opportunities.

Each automaker's cost exposure depends largely on its segment mix, carbon intensity of models, and geographic distribution of sales. A company's overall strategic positioning on low-carbon technologies also plays a significant role in market position. Through internal research and development choices and external partnerships and alliances, auto companies have different access to new technologies that may create value for the company in a carbon-constrained market.

More recently, WRI assessed the impacts of similar policies affecting the automotive industry in emerging markets. In particular, China has recently introduced fuel economy standards for passenger vehicles that are believed to be more stringent than the current U.S. regulations.[19] By assessing how each automaker's 2003 fleet in China compared to the standards beginning in 2005, WRI found automakers are positioned differently with respect to their proximity to meeting the new standards. Because China is an increasingly important market for automotive companies, competitiveness there will influence overall global profitability. As a result, competitive positioning with respect to China's new regulations will likely translate into a number of auto companies' financial results.

Two interesting themes can be identified from existing research that can be useful for investors assessing their portfolios' climate risk exposure: the potential financial impacts of climate policies are likely to vary *within* as well as *between* sectors.

- Measures of aggregate GHG emissions can only *identify* sectors that are exposed to regulatory risk and highlight the each sector's *potential relative exposure.* Some GHG-intensive sectors could see significant negative impacts due to certain structural characteristics of the industry, while other sectors could face relatively mild regulatory impacts and could find new market opportunities.
- Within GHG-intensive sectors, the ranges of possible impacts for companies are much wider. Analyses based on policy assumptions are helpful in illustrating the *potential variability of financial costs* depending on policy design options. These ranges reflect companies' different situations as a result of policy structure. However, even within a chosen policy structure, some companies will fare better than others, depending on their competitive response.

The relationship between climate risk exposure and GHG emissions is not linear. The competitive dynamics in each affected sector is inherently dependant on regulatory structure—which at this time is uncertain in the United States. Accurate estimates of the implications of climate policies hinge on knowing how they will affect cash flows and competitive positioning. In security analysis, competitive response to a regulatory framework is as important as assessing which sectors will be affected and when. How each company responds to regulatory risk vis-à-vis other companies in the sector will likely determine the relative impact on company finances.

Companies in the United States Have Reported How Different Policy Structures Could Affect Their Businesses

Policy uncertainty is also a problem for companies that must comply with future GHG requirements. Investors have recently pressed companies to disclose their climate risk, and three large electric companies with significant emissions—AEP, Cinergy, and TXU—have responded. All three companies highlighted the lack of policy certainty as a major issue for their business. Indeed, AEP stated "The central challenge the company faces is that of making decisions about large investments in long-lived assets in a setting of uncertain public policy and rapidly evolving technology."[20]

Policy uncertainty makes it difficult for companies and investors to determine the future cost of GHG emissions, value the assets that emit them, optimally allocate capital internally, or accurately project future revenues or profits. These issues also apply to other sectors with significant emissions and long-term capital investment decisions.

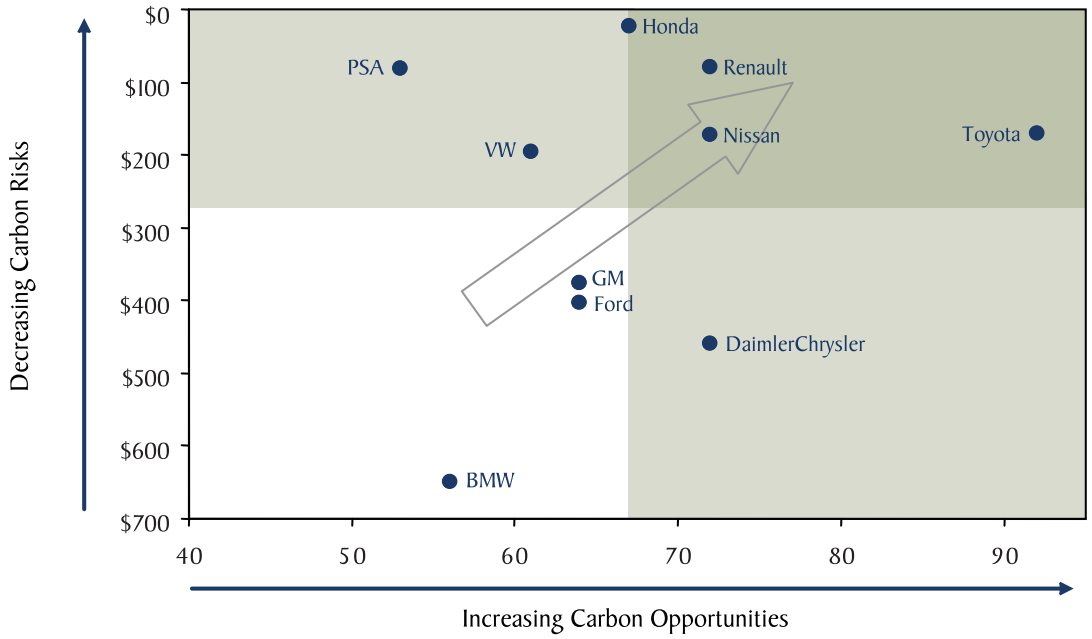

Figure 2. Carbon Positioning of Leading Automakers

Note: In this figure, risk is presented in terms of average additional cost per vehicle in 2015 (lower costs are better). The upside strategy opportunities are expressed as a qualitative score between 0 and 100 (higher scores are better). Original equipment manufacturers in the top right quadrant can be considered "lower carbon leaders" with below average exposure to risks and above average scores with regard to lower carbon technologies.

Source: WRI and SAM research.

Cinergy explained in detail its problems in planning and allocating capital and called upon government to set a limit on GHG emissions to end the uncertainty. The company stated:

> The uncertainties are particularly challenging for Cinergy and other utilities because we must routinely make long-term decisions to continue meeting the energy needs of our customers. It can take from 6 to 12 years to build a large base-load generating station on a new site, at a cost in excess of $1 billion. Early in the process, we must find the optimal location, design the plant, obtain permits, and finalize major engineering decisions. In an uncertain regulatory climate, these decisions must be made at the risk that they will not be optimal once the existing uncertainty is finally resolved. Cinergy works hard to manage this risk, and has done so successfully for years, but clearly, *the prompt adoption of a clear long-term federal environmental policy would benefit all.* [Emphasis added.][21]

The company went on to say that "The uncertainty Cinergy faces in the current regulatory climate has made it difficult to plan the capital expenditures we will need to make to comply with all environmental requirements while continuing to serve our customers' future energy needs in a reliable manner."

AEP noted that its "ability to develop a strategy to further reduce air emissions at the lowest cost to its consumers and shareholders over the long-term is complicated by uncertainties regarding the nature and scope of currently proposed requirements and the likelihood and timing of additional future emission reduction requirements."

All three companies were concerned that taking proactive measures in GHG mitigation in the short term could harm the company when future rules are adopted. Indeed, TXU argued that any investment in voluntary emissions reductions was unwarranted until the company understood the shape of a future GHG regulatory program.[22]

AEP, in its report to shareholders, quantified the impact of several policy scenarios for limits on emissions—the Environmental Protection Agency's (EPA) current proposal to regulate nitrogen oxides, sulfur dioxide, and mercury, but not CO_2; the proposed McCain-Lieberman Climate Stewardship Act; and the Clear Planning Act proposed by Senator Tom Carper (D-DE). These estimates illustrate the financial variability of different policy scenarios on company finances and the risks of uncertainty. AEP projects the costs of each policy scenario as follows:

- *EPA Regulations.* Would cost $3.5 billion through 2010, and a total of $5 billion through 2020. This would have a net present value (NPV) of $2.6 billion.
- *McCain-Lieberman.* Would cost an additional NPV of $0.5 billion to $0.9 billion over the EPA estimates, with the assumption that the legislation would allocate permits based on historic emissions.

- *Carper Clear Planning Act.* Would cost an NPV of $3.0 billion to $6.4 billion in addition to the EPA regulatory scenario. AEP attributes two-thirds of this additional cost to the legislation's method of allocating permits, which rewards companies that produce electricity with nuclear power or natural gas.

Moreover, AEP's analysis shows that allocating capital in an uncertain policy environment is risky. If regulations are more stringent than the McCain-Lieberman legislation, the company suggests that this could strand some of the $3.5 billion of pollution control investments planned between now and 2010, should such controls require early retirement of some of AEP's upgraded coal plants. This could also occur if the government decides on a less favorable approach to allocating permits than AEP assumed in its analysis.

These examples illustrate the difficulties that an uncertain policy environment causes both companies and investors trying to decide whether their investment will yield an attractive rate of return.

The Impact of Climate Policies Goes Beyond Direct Regulatory Costs

To assess more accurately the financial impact of climate policies on companies, investors must go beyond simple measures of GHG emissions and refer to cash flow analyses that take express account of the different forms of GHG constraints and their impact throughout the value chain. Analyzing competitive and financial implications of climate policies at company level is the best way to pick the winners and losers. For diversified investors, a good start is a sector-level analysis, but company-level analyses will reveal important differences in positioning within sectors. Consequently, even for a well-diversified portfolio, investors need to understand how climate policies will affect individual companies in order to advise portfolio allocation strategies. Most of the literature on climate risk has focused on direct regulatory cost, but to fully capture the impact of climate policies on investments, investors should also assess:

- The effects of climate risk throughout the value chain.
- The scope for passing on costs to consumers.
- The strategic response to climate policy.

Effects of Climate Risk throughout the Value Chain

Policymakers, academics, and some companies have tried to calculate GHG emissions from industry operations. However, the use or consumption of some goods and services may result in additional GHG emissions beyond those associated with production. Policies to limit GHG emissions may affect these sectors indirectly by reducing or increasing demand for the goods and services produced. Moreover, the degree to which climate policies affect a company's supply chain might affect input costs.

For example, consider the automotive sector. Three-quarters of an automobile's lifecycle carbon emissions come from the combustion of gasoline bought by the consumer.[23] Yet, these emissions do not show up in measures of carbon intensity of original equipment manufacturers (OEMs), which capture only the emissions involved in assembling the vehicle and producing raw materials (e.g., plastics, steel). However, an effective climate policy would include incentives to either increase fuel efficiency or decrease gasoline consumption, which could alter demand patterns within the automotive industry as consumers move toward more fuel-efficient models. In other words, GHG intensity of the production process alone may not always be an accurate indicator of cost exposure to climate policies. Instead, GHG emissions throughout the full lifecycle have to be analyzed to effectively determine competitive impacts.

These issues can also evolve around a company's supply chain. Companies will have to incorporate supply chain management (SCM) strategies that take into account how climate policies can affect cost structures. A reactive SCM strategy could entail anticipating regulatory impacts on suppliers and responding accordingly. A proactive SCM strategy might entail actively engaging suppliers to reduce GHG emissions (therefore reducing cost exposure) or restricting procurement to suppliers that meet GHG emissions criteria. The impact on profit margins in various sectors depends on the structure of climate policy.

Scope to Pass on Costs to Consumers

The demand for certain GHG-intensive goods and services may be inelastic because they are considered necessities or because short-term substitution opportunities are limited, or both. Hence, even if a climate policy seeks to limit GHG emissions from certain sectors, the immediate impact may be small, and the costs of long-term change may be passed on to consumers. For instance in the electric utility sector, whether new pricing structures are possible will affect the incentive to lower costs by switching fuels from the most carbon-intensive fossil fuels to cleaner fossil fuels; to switch from carbon-based fuels to renewable sources of energy; and to improve efficiency in generation, transmission, and distribution. Pricing flexibility also depends on whether the company is regulated. Consequently for the industry as a whole, the impact of a comprehensive climate policy might range from one in which costs increase and margins are squeezed to a situation in which there are significant opportunities to expand margins and pursue new market opportunities. In this situation, individual companies could win or lose depending on their efficiency, fuel mix, and strategic opportunities.

However, this range of outcomes is not necessarily indicative of upstream fuel providers with a different set of circumstances. The coal industry, for example, cannot "fuel switch" the way its downstream electric utility customers can. Either customers demand coal or they do not. A constraint on GHG emissions could therefore discourage combustion of coal—the most carbon-intensive fuel—thereby lowering demand for the entire sector. For the oil and gas industry, the effect could be positive or negative depending on a company's asset composition. For example, natural gas (which is less carbon-intensive) could benefit from rising demand as some utilities look to lower coal consumption in favor of cleaner fuels.

Strategic Response to Climate Policy

For most manufacturing industries, each company's response to GHG regulations could entail various options such as investments in low-carbon technology, emissions trading, investments in GHG-offset projects, or lobbying and legal efforts to head off GHG regulations, to name a few. These options involve different costs and can create different financial outcomes and competitive issues. In response to climate policies, corporate managers will have to develop strategies around:

- Direct regulatory costs.
- New market and product opportunities.
- Anticipated shifts in demand.
- Impacts of climate policies on the supply chain.
- Emissions trading (if applicable).
- Finance and accounting (e.g., including the cost of carbon in capital budgeting, GHG accounting, allocation of resources).

BP and Royal Dutch Shell are a good example of this dynamic. Both companies face climate risk in a number of their markets (as do their competitors). The way these companies choose to compete around climate policies can be evidenced by investments in cleaner fuels and technologies (BP Solar and Shell Renewables), improving efficiencies in their emissions trading capabilities,[24] and other similar types of strategies. Moreover, each company's brand, which seeks to differentiate them by their strategy, is another aspect of strategic positioning.

Climate Policies Can Also Affect Competitiveness in Non-GHG–Intensive Industries

Climate competitive issues are not restricted to GHG-intensive industries. There are also new market and product opportunities for companies that have core competencies related to the world's new emissions trading markets and produce little to no direct GHG emissions from their operations (e.g., professional services). For instance, the Kyoto Protocol and the EU ETS will create business opportunities in the financial services sector. These include:

- Investment banking activity (e.g., mergers and acquisitions, capital raising) as companies begin optimize structures of corporate portfolios.[25]
- New derivative financial products in emissions trading.
- Increased demand for corporate finance advisory services in light of new GHG asset/liability class. This opportunity extends to other professional services firms.[26]
- Private equity and project finance opportunities in renewable energy and GHG-offset projects falling under the scope of the Clean Development Mechanism and Joint Implementation in the Kyoto Protocol. A venture capital movement is also growing around clean technologies.
- Broadened trading operations in GHG emission markets, especially for entities with strong commodity businesses.

Climate Competitiveness Will Influence Corporate Profitability

At first glance, how climate policies can affect company profitability might not be entirely clear. This report has focused on competitive issues, but each climate risk mechanism can potentially change cash flows and profitability. As mentioned, climate policies can come in many forms, presenting both costs and opportunities for companies in many sectors. How much cash flows will be affected depends on companies' skill in managing their strategic response to climate policy, innovating around new product and market opportunities, mitigating regulatory costs, investing their capital, and managing their supply chain.

Climate policies can affect both operating and nonoperating expenses. Indeed, the costs of some climate policy scenarios might entail only nonoperating costs in the form of taxes or capital expenditures (and the possible effect on debt costs). Other policies might offer opportunities to increase operating profit through different pricing structures or emissions trading. Below are some examples of ways climate policies can affect profitability.

- *Revenues.* Changes in demand patterns, pricing structures, new product and market opportunities.
- *Cost of goods sold.* Changes in pricing structures throughout the supply chain.
- *Operating costs.* Changes in production cost structures, emission trading expenses.
- *Capital expenditures.* Investments in new capital assets to reduce GHG emissions (could also affect depreciation expense).
- *Taxes.* Possible effects on tax deductibles.

Climate policies do not affect only companies headquartered in a country that regulates GHG emissions. For instance, U.S.-based companies with operations in GHG-intensive sectors in the EU will be affected by EU regulations. Some U.S.-based companies are now considering how climate policies could affect their finances as they try to compete in a carbon-constrained world.

Cinergy, for instance, in its recent report to shareholders, stated that its costs would probably increase as a result of any regulation of GHGs in the United States.[27] However, the company expressed less certainty about the precise effects of these costs. According to the report, Cinergy's costs could rise due to:

- Increased capital expenditures associated with investments to improve plant efficiency, install GHG emission reduction technology, or construct alternatives to coal generation.
- Increased operating and maintenance expenses because some of their coal units will be forced to cycle output up and down more frequently.
- Reduced operating hours for their oldest generating stations because the additional carbon costs could increase the number of hours these stations operate "out of the money" compared to wholesale power prices.
- Increased expenses associated with the purchase of carbon emission allowances (if a market is created) or the imposition of a carbon tax.

Companies that emit GHGs will increasingly face regulatory risk in the United States and abroad. This risk should be quantified and discounted to value a company's securities accurately. However, uncertainty about the future regulatory landscape in the United States makes any financial analysis of climate competitiveness over standard timeframes difficult.

PRELIMINARY TOOLS TO DISCOUNT CLIMATE RISK IN VALUING SECURITIES

Investors and analysts use a variety of analytical tools to determine the appropriate value of a company's equity.[28] This determination largely guides the assessment of risk and return in investment decisions. The value of an equity security should theoretically reflect the present value of the issuer's future cash flow streams. *We acknowledge other valuation methods but focus in this section on discounted cash flow analysis because it provides a more comprehensive basis for discussion.* The financial concepts discussed below are not novel. Financial analysts use these and other techniques to discount uncertainty in investment decisions. However, we believe they can be useful in discounting uncertainty on climate polices in security analysis.

Ideally, investors would know the chosen climate policy and could appropriately estimate the financial and competitive implications for a company. Cash flow estimates would reflect the costs associated with these regulations, new product and market opportunities and their impacts on revenues and profitability, potential tax consequences, and real options analyses. In other words, as the impacts of climate policy become more visible, cash flow estimates become more robust. However, for investments in the United States, the structure of a future U.S. climate policy is difficult to predict, and the ideal is not a viable option.

Lacking Clarity on the Structure of Climate Policies, Investors Can Use Existing Techniques to Discount Climate Risk

In absence of clarity about future U.S. climate policy, investors can use existing financial concepts to adjust for climate risk and uncertainty. To incorporate regulatory uncertainty in standard discounted cash flow analyses, there are two basic options. If we choose to ignore adjusting the estimated terminal value[29] as well as the timeframe of cash flow estimates (which for this discussion is inconsequential), we can separate discounted cash flow analyses into two basic variable sets. One is the actual estimate of cash flows and the other is the discount rate. From this starting point, we can choose which variable set can be adjusted to reflect climate risk. The approach outlined below is descriptive only and falls short of suggesting the relative magnitude of adjustments to cash flows or discount rates.

Option I: Risk-Adjustment Factors to Cash Flow Estimates

One option to reflect climate risk is adjusting cash flow estimates according to an assessment of competitive positioning around climate policies. In other words, investors can separate cash flows into those that will likely be affected by GHG constraints and those that will not.

> *The expected cash flows likely to be affected by GHG constraints can be adjusted to incorporate risk posed by climate policies.*

The cash flow estimates from cleaner assets/businesses will not be adjusted. By combining both sets of cash flow estimates and discounting them by the preferred discount rate, the investor can arrive at a company's "climate-adjusted" value.

This approach, though generally preferable in analytical terms to the risk-adjusted discount rate discussed below, is also highly dependant on general assumptions of policy stringency. The inclusion of risk-adjustment factors in cash flow estimates (which could entail, for example, carbon shadow prices or certainty equivalent factors) will generally require explicit judgments about the magnitude of the financial impacts of

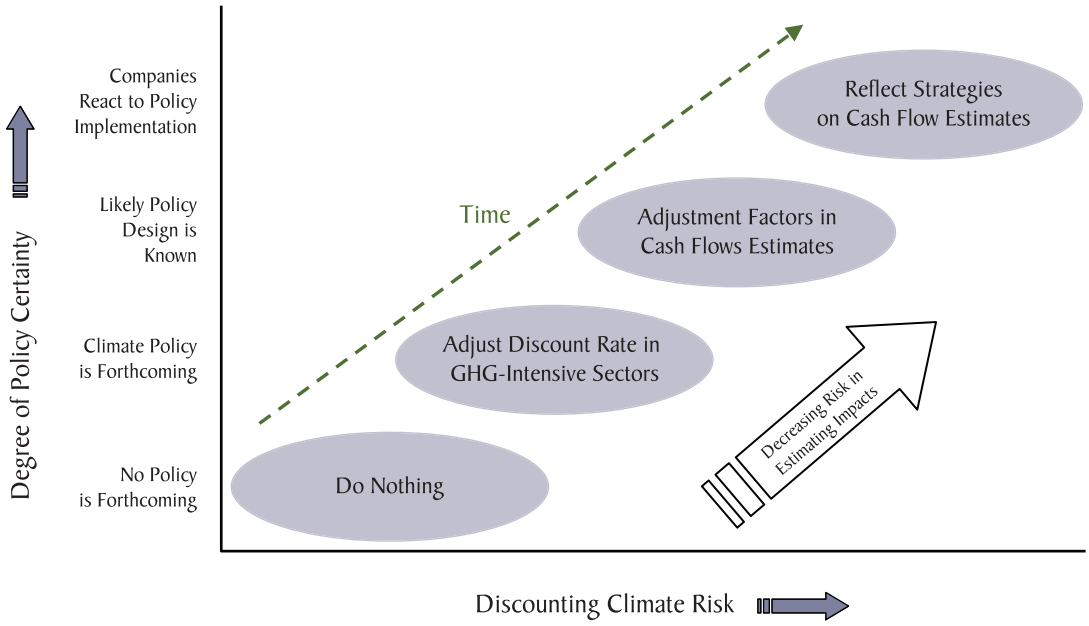

Figure 3. Reflecting Climate Risk Uncertainty in Discounted Cash Flow Analyses

Source: WRI Capital Markets Research.

climate policies. As a result, risk-adjustment factors, though a more robust tool, are again only as reliable as the underlying assumptions used to make the adjustments.

This approach is probably better suited for an environment in which the regulatory structure is known, or becoming clear, even if the implementation of the policy is less certain. For example, investors may know that the policy structure is an emissions trading system but not know the allowance allocation process.

Option 2: Climate Risk-Adjusted Discount Rates

Another approach is to maintain unadjusted estimates of cash flows and adjust the discount rate by applying a risk premium to companies in GHG-intensive sectors. Investors can adjust for greater uncertainty by increasing the discount rate in valuing these investments. A higher discount rate reflects the higher rate of return needed to match greater perceived risk. Such a "climate risk premium" could be adjusted to reflect initial assessments of competitive positioning.

> *The expected cash flows are unchanged, but the required rate of return (discount rate) is adjusted upward to incorporate the added potential risk from climate regulations.*

A climate risk-adjusted discount rate should reflect, in essence, a company's relative risk exposure to GHG constraints. The advantages to this method are that risk-adjusted discount rates are easily understood and analytically uncomplicated. Moreover, because it is currently easier to estimate the relative exposure of various *sectors* to GHG regulations than competitive positioning within these sectors, the risk-adjusted discount rate option might be more appropriate to reflect climate risk across a diversified portfolio in a period of policy uncertainty. However, this method is very imprecise because it fails to fully incorporate competitive dynamics around carbon constraints.

Using climate risk-adjusted discount rates poses an additional problem: this approach reflects an implicit assumption that climate risk is distributed evenly across time. This is unlikely to be the case because competitiveness, and therefore financial impact, is not static. Companies will react to strategies that either work or do not work. Market dynamics are fluid, and the implications of climate competitiveness on cash flows will change throughout time.

CONCLUSIONS

This report offers investors a way to begin to analyze climate risk. It is important for investors to analyze the effects of climate policies on their portfolios and begin to take appropriate steps to mitigate this risk. The framework provided in this report is useful for structuring an analysis of issues surrounding climate risk, policy uncertainty, and investing. More research is needed to assess the magnitude of financial implications of climate policy and its distributed effect through various sectors of the economy.

Climate risk faced by companies comes in different forms, each one posing different analytical challenges. For investors, the most immediate climate risk mechanism arises from the GHG regulations currently existing at the international, national, regional, and state levels. In light of the international trend to regulate GHGs, current and proposed climate policies in the United States are likely to gain strength. Investments in companies operating in these jurisdictions could be either positively or negatively affected by these policies.

For investors, competitive positioning around climate regulations provides an opportunity to differentiate companies around climate risk. Various studies have shown that the effects of climate polices on company finances and competitive positioning are likely to be material. Companies with proactive climate strategies that maximize opportunities and minimize costs will be better positioned in a carbon-constrained world than companies that have no such strategies.

However, to analyze these financial and competitive implications accurately, investors need more clarity on the eventual structure of climate policy in the United States. This uncertainty also extends to the degree of interaction between policies in the United States and abroad. Not knowing these new parameters could prove problematic in estimating the fair value of companies held in a portfolio. This, in turn, could increase overall investment risk to the detriment of portfolio performance.

Despite this uncertainty, investors can begin to assess relative GHG exposure among sectors, as well as use existing financial techniques to discount the potential financial implications on companies.

Notes

1. The foundation for Modern Portfolio Theory was established by Harry Markowitz in "Portfolio Selection," *Journal of Finance* 7, no. 1 (March 1952) pp. 77–91; and in *Portfolio Selection—Efficient Diversification of Investments* (New York: John Wiley & Sons, 1959).
2. In financial terms, such assets have little or negative covariance.
3. Leon Panetta, Institutional Investors' Summit on Climate Change, United Nations, New York, November 21, 2003.
4. The greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), hydroflurocarbons (HFCs); perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).
5. E. Lambert, "Spitzer Strikes Again," ***Forbes.com***, July 21, 2004.
6. For information on the Chinese standards, see A. Sauer and Fred Wellington. *Taking The High Fuel Economy Road: What do the New Chinese Fuel Economy Standards Mean for Foreign Automakers?* (Washington, D.C.: World Resources Institute, 2004).
7. The Kyoto Protocol requires industrial countries that have ratified the treaty to reduce GHGs on average by 5.2 percent below 1990 levels by 2012. The Protocol officially went into effect on February 16, 2005. The EU ETS is designed to be compatible with the EU's commitments to the Protocol.
8. For information on the EU agreement, see Amanda Sauer, P. Mettler, F. Wellington, and Gabriela Hartman. *Transparency Issues with the ACEA Agreement: Are Investors Driving Blindly?* (Washington, D.C. and Zurich, Switzerland: World Resources Institute and Sustainable Asset Management, 2005).
9. *Climate Change Plan for Canada,* November 2002.
10. M. Bustillo, "Canada OKs Auto Emissions Pact". *Los Angeles Times,* March 24, 2005.
11. For an in-depth description of U.S. climate-related legislation and congressional activity, see the Pew Center on Global Climate Change web site; **http://www.pewclimate.org/policy_center/congressional/**.
12. American Electric Power's report can be found at **http://www.aep.com/environmental/performance/emissionsassessment/default.htm**. Columbus: August 31, 2004, pp. 4, 12. (accessed February 2005).
13. TXU's report (Boston, September 2004, p. 31)can be found at **http://www.txucorp.com/responsibility/environment/reports/Env_Study100104.pdf**. (accessed February 2005).
14. For more information on the types of climate policies, see Box 2.
15. Direct allocation refers to a situation in which installations are granted permits free of charge based on emissions data. Auctioning permits refers to a situation in which permits are auctioned to installations for a fee.
16. L.H. Goulder, *Mitigating the Adverse Impacts of CO2 Abatement Policies on Energy-Intensive Industries.* Resources for the Future, Discussion Paper 02–22, March, 2002.
17. A.E Smith and Martin T. Ross, *Allowance Allocation: Who Wins and Loses Under a Carbon Dioxide Control Program?* Report prepared for the Center for Clean Air Policy (Boston: Charles River Associates, February 2002).
18. Duncan Austin, Niki Rosinski, Amanda Sauer, and Colin Le Duc, *Changing Drivers: The Impact of Climate Change on Competitiveness and Value Creation in the Automotive Industry.* (Washington, D.C.: World Resources Institute, 2003).
19. Amanda Sauer and Fred Wellington. *Taking the (High) Fuel Economy Road: What Do the New Chinese Fuel Economy Standards Mean for Foreign Automakers?* (Washington, D.C.: World Resources Institute, 2004).
20. American Electric Power, *An Assessment of AEP's Actions to Mitigate the Economic Impacts of Emissions Policies* (Columbus: AEP, August 2004).
21. Cinergy Corporation, *An Analysis of the Potential Impact of Greenhouse Gas and Other Air Emission Regulations on Cinergy Corp.* (Cincinnati: Cinergy Corporation., December, 2004).
22. TXU Corporation, *TXU Activities Regarding Actual and Potential US Air Emissions and Climate Change Police* (Dallas: TXU, September 2004).
23. Malcolm Weiss, John Heywood, Elisabeth Drake, Andreas Shafer, Felix Au Yeung *On the Road in 2020: A Lifecycle Analysis of New Automobile Technologies,* MIT Energy Laboratory Report # MIT EL 00-003, Cambridge Mass., October 2000.
24. Shell's system is called the Shell Tradable Emission Permit System (STEPS) and was initially voluntary, attracting about 30 business units from its January 2000 start. These units accounted for around 30 percent of the group's GHG emissions, which in 1998 amounted to roughly 97 million metric tons of CO_2 equivalent. BP's scheme was rolled out across the whole company in 2000 after a pilot program was launched in 1998 covering 12 business units.
25. One example of this opportunity is described in F. Guerrera, "Bidders Target Pacific Hydro as Kyoto Looms," *Financial Times,* December 21, 2004.
26. In December 2004, the International Financial Reporting Interpretations Committee of the International Accounting Standards Board provided guidance on balance sheet accounting for GHG assets and liabilities. See **www.iasb.org**.
27. Cinergy Corporation, "*An Analysis of the Potential Impact of Greenhouse Gas and Other Air Emission Regulations on Cinergy Corp.*" (place: Cinergy, December 2004).
28. We focus on equity for discussion purposes only. Climate risk can also affect credit quality if regulatory costs and competitive pressure on profit margins impair a company's ability to meet its debt obligations.
29. A company's *terminal value,* which is a function of cash flow estimates, reflects the value of the firm's cash flows in perpetuity.

Ceres is a coalition of investment funds, environmental organizations, and public interest groups. Ceres' mission is to move businesses, capital, and markets to advance lasting prosperity by valuing the health of the planet and its people. Ceres serves as the Secretariat for the Investor Network on Climate Risk (INCR). INCR was launched by U.S. institutional investors managing over $700 billion in assets at the Institutional Investor Summit on Climate Risk at United Nations Headquarters in 2003. The purpose of INCR is to promote better understanding of the risks of climate change among institutional investors.

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